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Amdt. Dated: May 11, 2004

Reply to Office action of March 12, 2004.

### REMARKS

The Applicants affirm the provisional election of the Group I claims, claims 1-26, made by Mr. Andrew Caruso on February 27, 2004, during a telephone conversation with the Examiner.

In the Office Action dated March 12, 2004 the Examiner states that (quote) :

"Claims 6 and 19 are objected to because the term "with in" does not appear to be grammatically correct. Appropriate correction is required."

The claims 6 and 19 have been amended to recite --with -- instead of "with in".

Claim 10 has been amended to correct a typographical error. It was intended that claim 10 recite -- wherein the brine solution in step b) -- instead of "wherein the brine solution in step c)". The phrase -- wherein the brine solution in step b) -- is the same formulation used in original claim 23 and logically relates to the second functionalized resin recited in claim 10 since the second functionalized resin is the resin being used in step b).

### 35 USC § 103 (a) Rejections

The Examiner has rejected claims 1-26 under 35 USC 103 (a) as being unpatentable over Silva et al. (US 6,426,008) or WO 01/14252 in view of Silva et al. (US 6,214,235). The Examiner has further rejected Claims 1-4 and 7-13 under 35 USC §103 (a) as being unpatentable over Silva et al. (US 6,426,008) or WO 01/14252 in view of Vaughn et al. (US 4,747,957). The Applicants courteously traverse these rejections.

The Examiner states that (quote) :

- o "Each of the primary references discloses purifying brine for use in a membrane electrolyzer (see col. 1, line 10 of Silva et al.; and page 1, lines 5-6 of WO 01/14252) by subjecting this brine to the recited pH adjustments and functionalized resin treatments at the recited conditions. (se col. 13, line 12

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through col. 14, line 32 of Silva et al. ; and page 23 , line 3 through page 24, line 28 of WO 01/14252)."

The Examiner further states that (quote):

- o "Accordingly each of these primary references discloses the claimed invention with the exception of the recited polishing treatment. The secondary reference discloses that brines of the type recited (see col. 3, lines 9-10) must be treated with adsorbents of the type recited (see col. 2, lines 19-20 and 23) if these brines are to be used in membrane electrolyzers (see col. 1, lines 18-26 and 31-24)."

The Examiner goes on to state that it would have been obvious to one of ordinary skill in the art at the time the invention was made to substitute the brine of the secondary reference for the brine of either primary reference, since this secondary reference is capable of functioning, after the appropriate adsorbent treatment, in a membrane electrolyzer in substantially the same manner as the brine of either primary reference, to product substantially the same results.

The Examiner further states that (quote) :

- o "Furthermore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to subject this brine to the purification treatment of either primary reference and then to the additional treatment of the secondary reference (i.e polishing), in order to allow this brine to be used in the membrane electrolyzers of either primary reference (see col. 1 line 10 of Silva et al.; and page 1, lines 5-6 of WO 01/14252)."

In contrast to earlier methods of brine purification, the Applicants have discovered that the sequence of the purification steps is key to successful brine purification. Thus the Applicants' broadest claim (claim 1) recites:

A method for removing impurities from a brine solution, said brine solution comprising a water soluble chelating agent, the method comprising the steps of:

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- (a) adjusting the pH of the brine solution to a pH of from about 2 to about 4 and passing the brine solution through a first functionalized resin; said first functionalized resin having functional groups capable of removing transition metal cations from the brine solution;
- (b) adjusting the pH of the brine solution to a pH of from about 9 to about 11.5 and passing the brine solution through a second functionalized resin, said second functionalized resin having functional groups capable of removing alkaline earth metal cations from the brine solution; and
- (c) subjecting the brine solution to a polishing step following step b).

The Applicants' claimed invention clearly requires that the "polishing step" (step (c)) follow step (b). There is no suggestion in the prior art that the order of the brine purification steps (a)- (c) is critical to the successful purification of the brine. The Applicants respectfully assert that, contrary to the Examiner's statement it would not have been obvious to one of ordinary skill in the art at the time the invention was made to subject this brine to the purification treatment in sequence such that the polishing step (c) was required to follow step (b). No combination of the primary Silva reference and the secondary Silva reference can be fairly construed to disclose or suggest the Applicants' claimed invention. The Applicants respectfully submit that there is no motivation to combine primary Silva reference and secondary Silva reference, in any particular order to provide a purified brine for use in a membrane electrolyzer.

To aid in the examination process Applicants draw the Examiner's attention to Table 1 (Application page 23, provided below for the sake of convenience) containing the "Voltage increase rate" data for the brine purified by following Method 1 in which the polishing step (c) takes place prior to step (b), and Method 2 and Method 3 in which the polishing step (c) follows step (b). The data very clearly indicate that the rate of voltage increase per hour is relatively high when the brine is purified using Method 1, compared

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to Method 2 and Method 3. The order of the steps followed in Method 1, Method 2 and Method 3 are discussed below.

TABLE1

| Example | Brine     | ppm Sodium Gluconate | Treatment | Voltage increase Rate |
|---------|-----------|----------------------|-----------|-----------------------|
| 1       | Ultrapure | 0                    | Method 1  | 4 mV/hr               |
| 1       | Ultrapure | 0                    | Method 2  | 1 mV/hr               |
| 2       | Recycle   | 350                  | Method 1  | 18 mV/day             |
| 2       | Recycle   | 350                  | Method 2  | 4.6 mV/day            |
| 3A      | Recycle   | 250                  | Method 1  | 64 mV/hr              |
| 3A      | Recycle   | 250                  | Method 1  | 38 mV/hr              |
| 3A      | Recycle   | 250                  | Method 1  | 15 mV/hr              |
| 3B      | Recycle   | 250                  | Method 2  | 0.05 mV/hr            |
| 4       | Recycle   | 100                  | Method 3  | 0.2-0.3 mV/hr         |
| 4       | Recycle   | 100                  | Method 3  | 0.2-0.3 mV/hr         |

**Method 1:**

Method one includes the steps of "polishing" (A), followed by purification steps (B and C).

A. AMBERSORB 572 (pH 3.5, 2 bed volumes/hr)

B. Transition Metal Cation Removal (pH 3.5, 2 bed volumes/hr)

C. Hardness Removal (pH 10.4, 2 bed volumes/hr)

**Method 2 :**

Method two includes the steps of polishing (A), followed by purification steps (B and C) and then followed by a second polishing step (D).

A. AMBERSORB 572 (pH 3.5, 2 bed volumes/hr)

B. Transition Metal Cation Removal (pH 3.5, 2 bed volumes/hr)

C. Hardness Removal (pH 10.4, 2 bed volumes/hr)

D. AMBERSORB 572 (pH 10.4, 2 bed volumes/hr)

**Method 3:**

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Method two includes purification steps (A and B) and then followed by a polishing step (C).

- A. Transition Metal Cation Removal (pH 3.5, 2 bed volumes/hr)
- B. Hardness Removal (pH 10.4, 2 bed volumes/hr)
- C. AMBERSORB 572 (pH 3.5, 2 bed volumes/hr)

The Applicants' data (Table 1) show clearly that much more effective control of the "voltage rate increase" is achieved when a brine purification method of the Applicants' claimed invention (Methods 2 and 3) are employed.

Because no combination of the references cited discloses or suggests the Applicant's claimed invention, the Examiner has failed to make a prima facie case of obviousness required to sustain rejection under 35 U.S.C. 103(a). For this reason the Applicants respectfully request that the rejection of claims 1-26 under 35 U.S.C. 103(a) as being unpatentable over Silva et al. (US 6,426,008) or WO 01/14252 in view of Silva et al. (US 6,214,235) be withdrawn.

The Examiner has rejected claims 1-4 and 7-13 under 35 U.S.C. 103(a) as being unpatentable over Silva et al. (US 6,426,008) or WO 01/14252 in view of Vaughn et al. (US 4,747,975). The Examiner states (quote):

- o "Each of the primary references discloses the claimed invention with the exception of the recited polishing treatment. Vaughn et al. discloses a similar process for purifying brine to be used in a chloralkali cell (co. 6, line 34), and teaches subjecting this brine to a polishing treatment after conventional treatment after a conventional[ly] ion exchange resin treatment, in order to catch any hardness values that escape through the ion exchanger (col. 6, lines 25-30)."

The Examiner goes on to state that accordingly, it would have been obvious to one of ordinary skill in the art at the time the invention was made to subject the treated brine of either primary reference to the polishing treatment of Vaughn et al., in order to obtain the advantages of this secondary reference for the process of either primary reference.

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The Applicants respectfully assert, that the process taught in Vaughn et al. teaches the use of ethylene/acrylic acid copolymers (EAA) fibres in a "polishing step" to prevent "break-through" of ionic species responsible for brine "hardness" after the ion exchange resin becomes fully saturated with such ions. The Applicants respectfully submit that a careful reading of Vaughn et al. shows that the "polishing" step disclosed in Vaughn et al. does not constitute a polishing step within the meaning employed by the Applicants in the instant invention. The polishing step disclosed in Vaughn et al. is carried out to remove "hard" ions,  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$ , referred to in Vaughn as "hardness values", and the adsorbent employed by Vaughn et al. is an ion exchange resin, not a "carbonaceous adsorbent" as employed in the instant invention. As the Applicants' disclosure makes clear (See paragraphs 54-56) the carbonaceous adsorbents employed in the polishing step of the instant invention are designed to remove impurities introduced by the ion exchange resins used in steps (a) and (b) of the instant invention. These impurities are not "breakthrough" of brine contaminants ( $\text{Ca}^{++}$  and  $\text{Mg}^{++}$ ) but are thought to be small organic molecules which are leached from the ion exchange resins used in steps (a) and (b). Further, those skilled in the art will understand that the carbonaceous adsorbents used in the polishing step of the instant invention are chemically different from the ethylene-acrylic acid copolymer fibres (EAA fibres) used in the "polishing step" disclosed by the Vaughn reference. The carbonaceous adsorbents used in the method of the instant invention have very limited ability to bind cations such as  $\text{Ca}^{++}$  and  $\text{Mg}^{++}$ . As the Vaughn reference makes clear in Example 1 (column 4, lines 57-68 and column 5, lines 1-7) the EAA fibres are a type of ion exchange resin which exchanges sodium ions for calcium and magnesium ions present in the brine. Moreover, the EAA fibres owe their binding ability to the relatively high concentration of carboxyl groups present in the ethylene/acrylic acid copolymer. Thus, the "polishing" step disclosed in the Vaughn reference is carried out using a different type of resin and is carried out for a different purpose than the "polishing" step of the instant invention. The Applicants also disclose that the polishing step of the instant invention may help remove quaternary ammonium salts (QS) present in the brine undergoing purification.

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The Applicants respectfully submit that no combination of Silva et al. (US 6,426,008) or WO 01/14252 with Vaughn et al. (US 4,747,975) either discloses or suggests the Applicants' claimed invention. In view of these remarks, it is respectfully requested that the rejection of claims 1-4 and 7-13 under 35 USC § 103 (a) as being unpatentable over Silva '008 or WO 01/14252 in view Vaughn be withdrawn.

In view of the foregoing, the Applicants respectfully submit the application is now in condition for allowance. Favorable reconsideration and prompt allowance of the claims are respectfully requested.

Should the examiner believe that anything further is needed to place the application in even better condition for allowance, the Examiner is requested to contact the Applicants' undersigned representative at the telephone number below.

Respectfully submitted,

  
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